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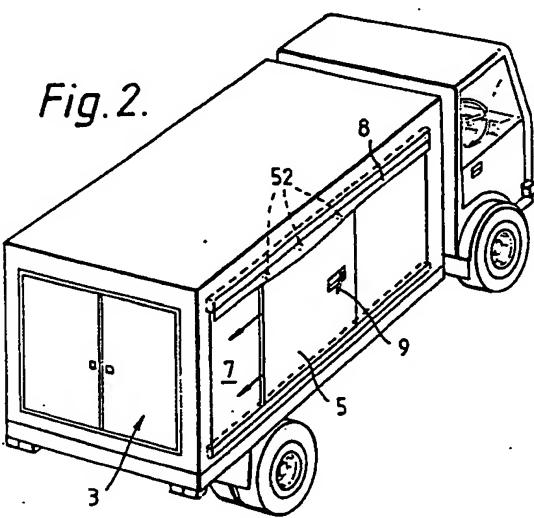
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(54) Sliding door system for vehicle

(57) Sliding door system (1) for a vehicle including one or more simple sliding doors (7) and a "master" plug-and-slide door (5) suspended from a carriage (50) which runs in a track (11a) disposed vertically above the track (11b) in which the simple doors (7) run. The carriage (50) includes a swing arm (52) which carries the "master" door (5) and which is free to swing in such a direction that when the "master" door (5) is slid towards its closing position and against a stop on the track, it swings the "master" door in to line with the simple doors (7). The abutting edges of the doors and one edge of the door frame are provided with a complementary tongue and groove and a lock is provided on the "master" door (5) which urges the doors together, forcing the tongues in to the grooves to lock all of the doors and provide a seal between the door.



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Fig.1.

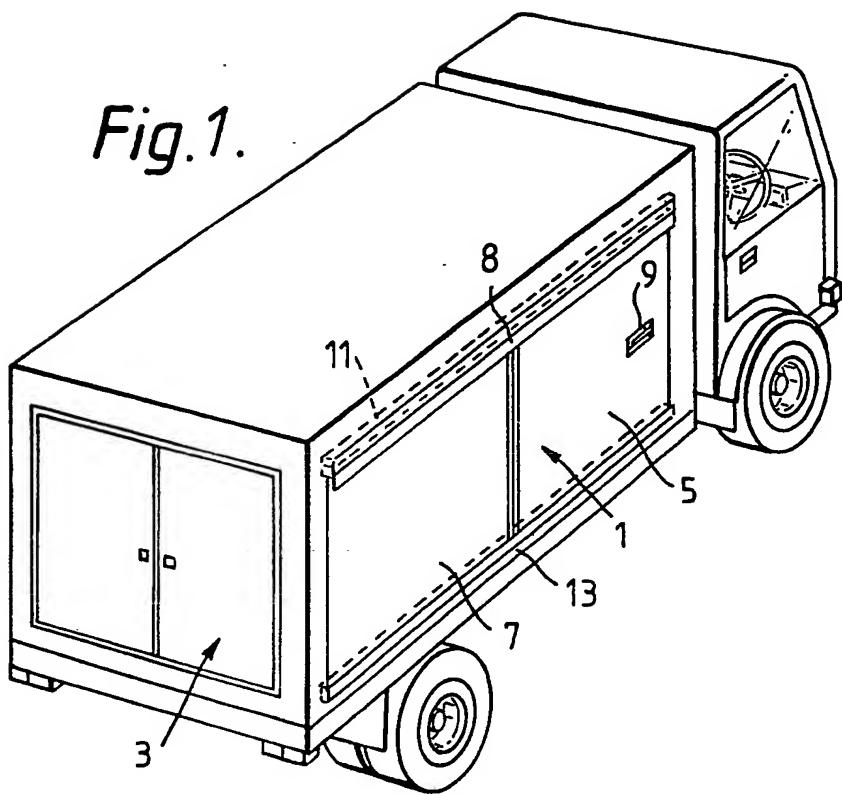
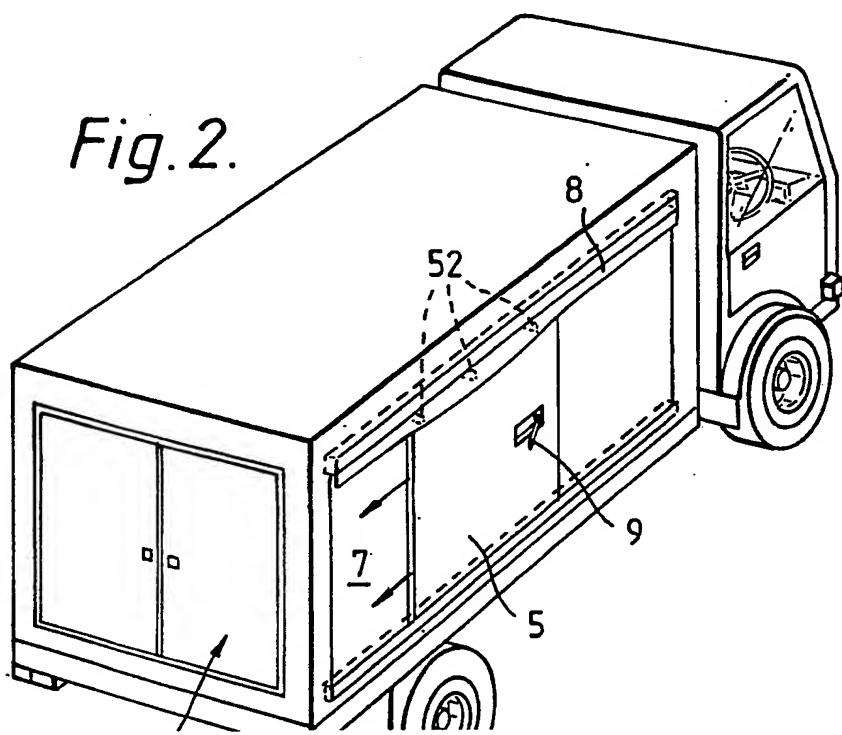


Fig.2.



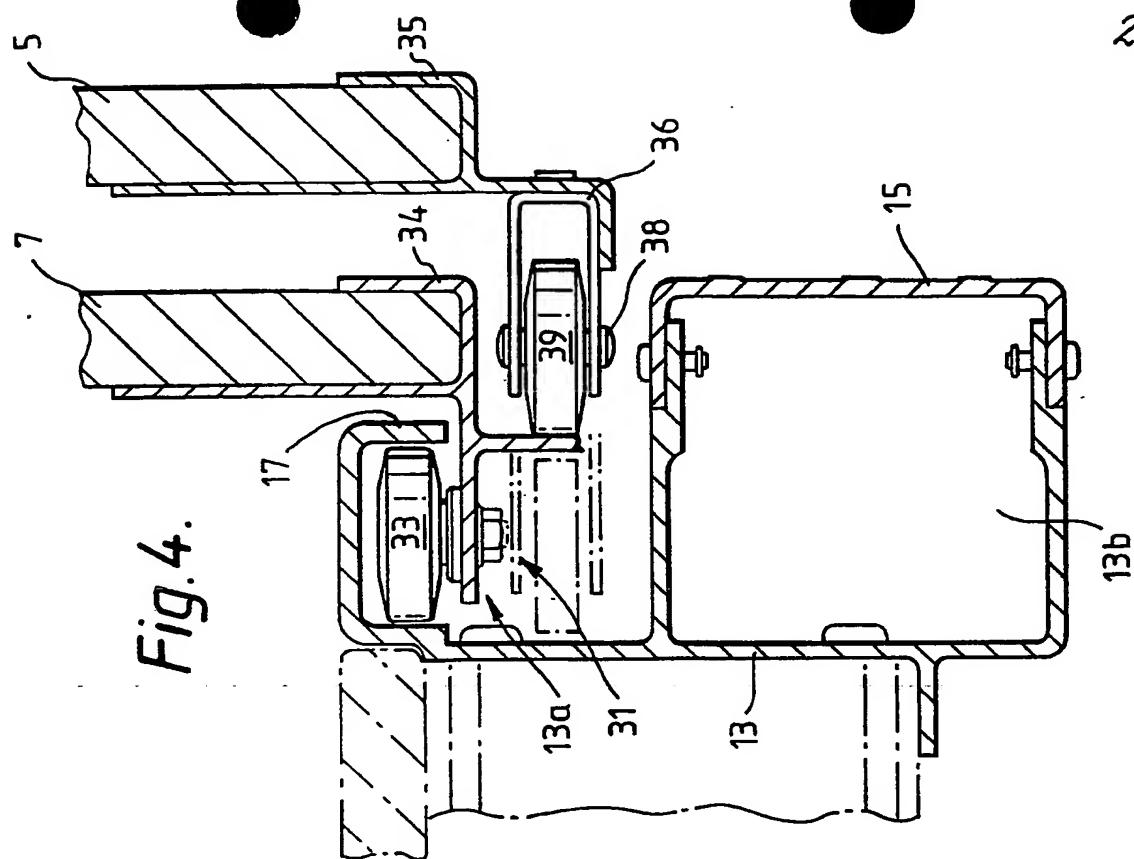
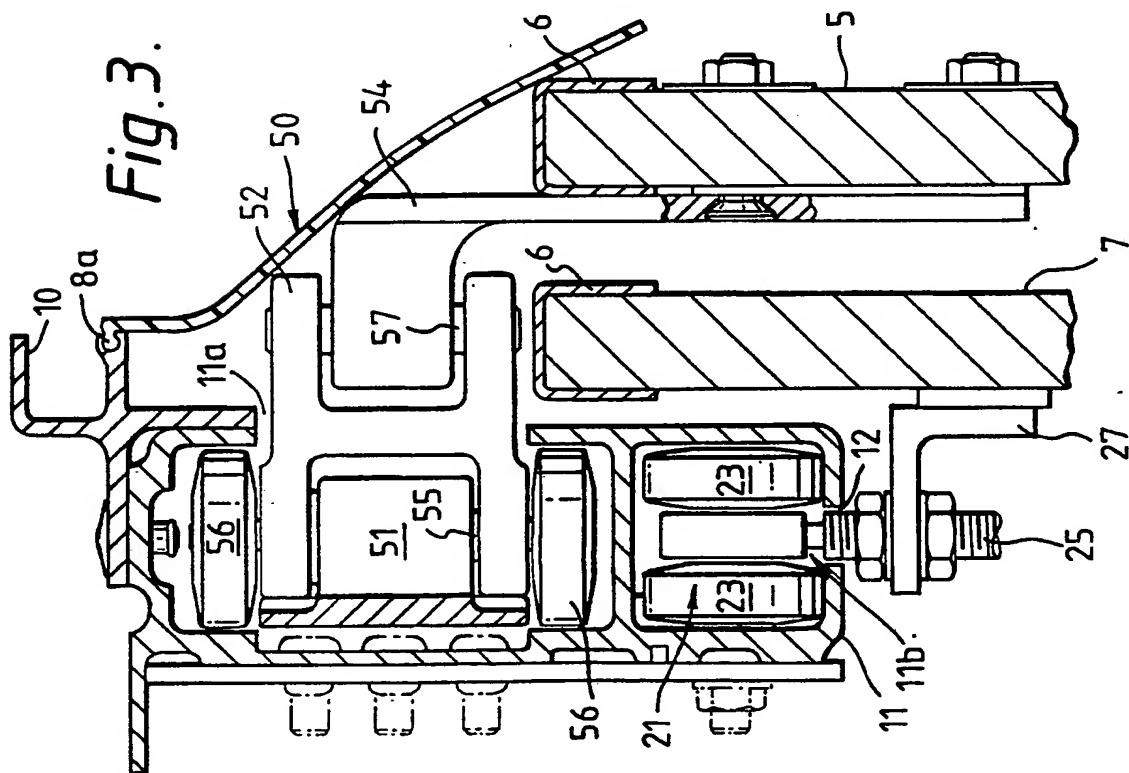


Fig. 3.



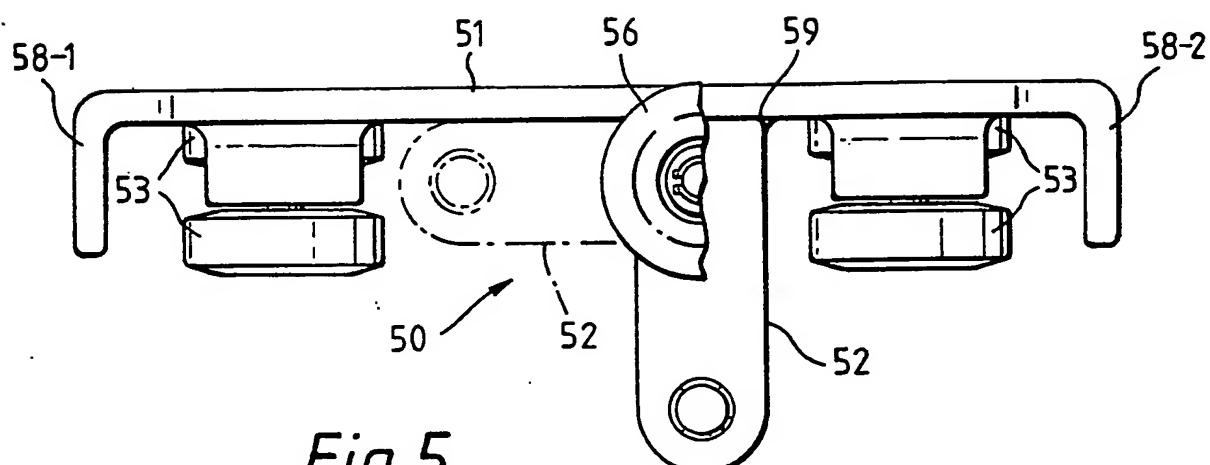


Fig. 5.

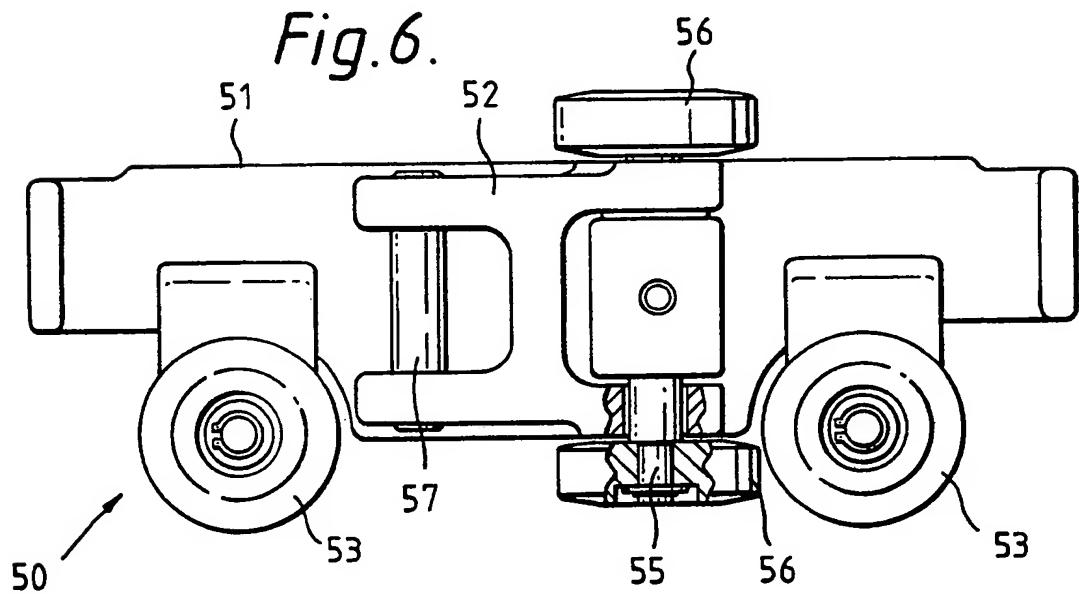


Fig. 6.

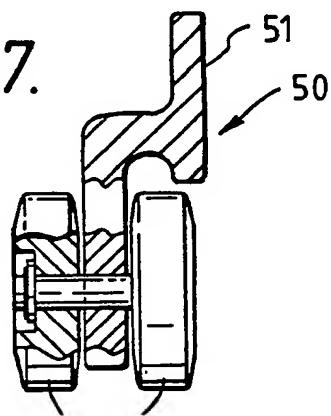


Fig. 8.

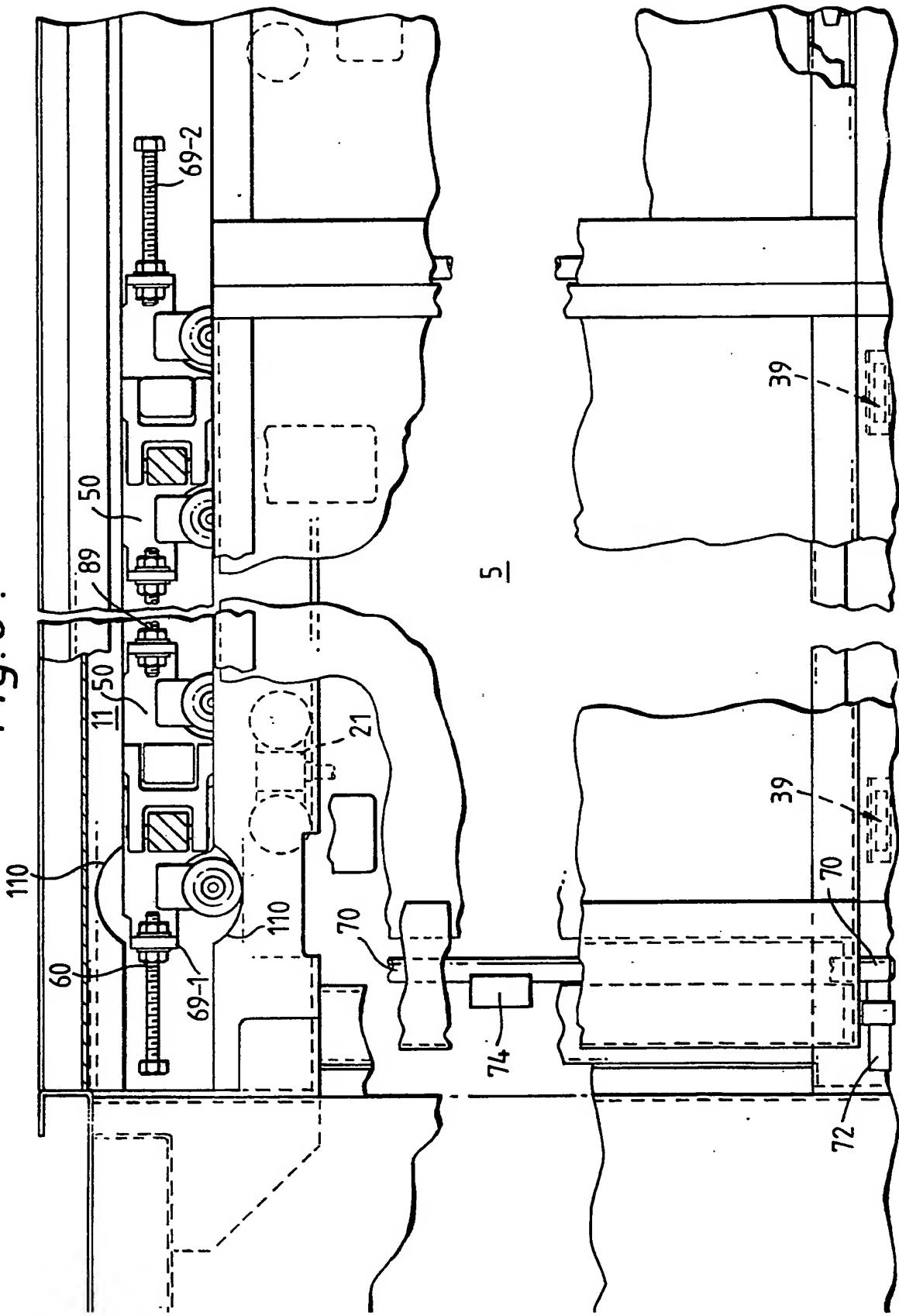


Fig. 9.

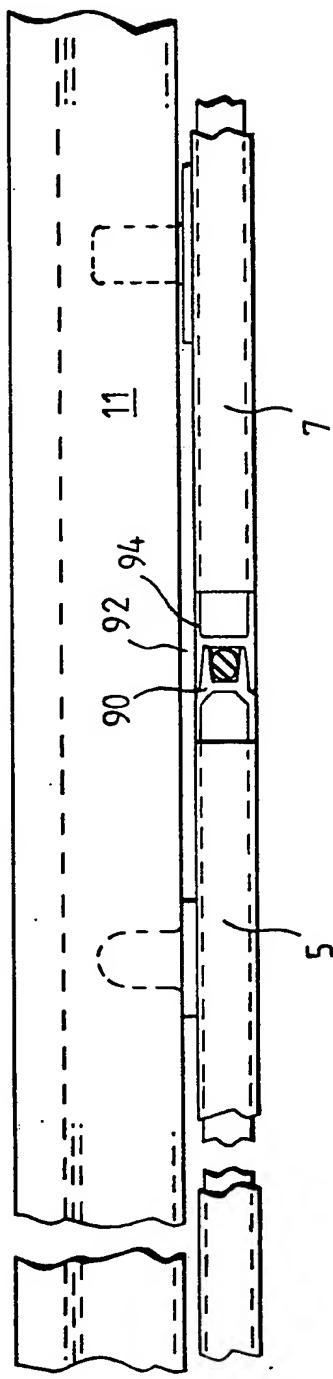
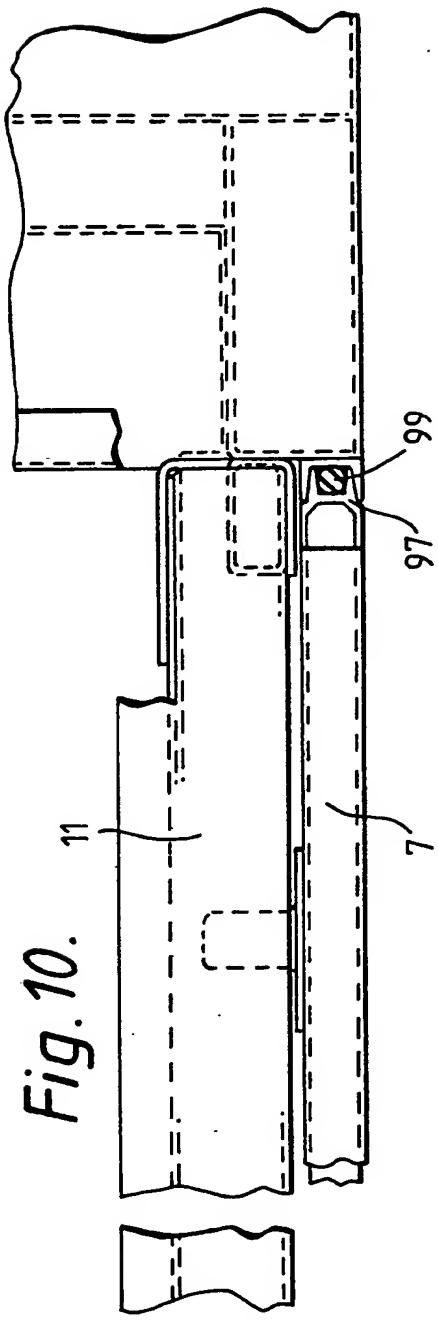
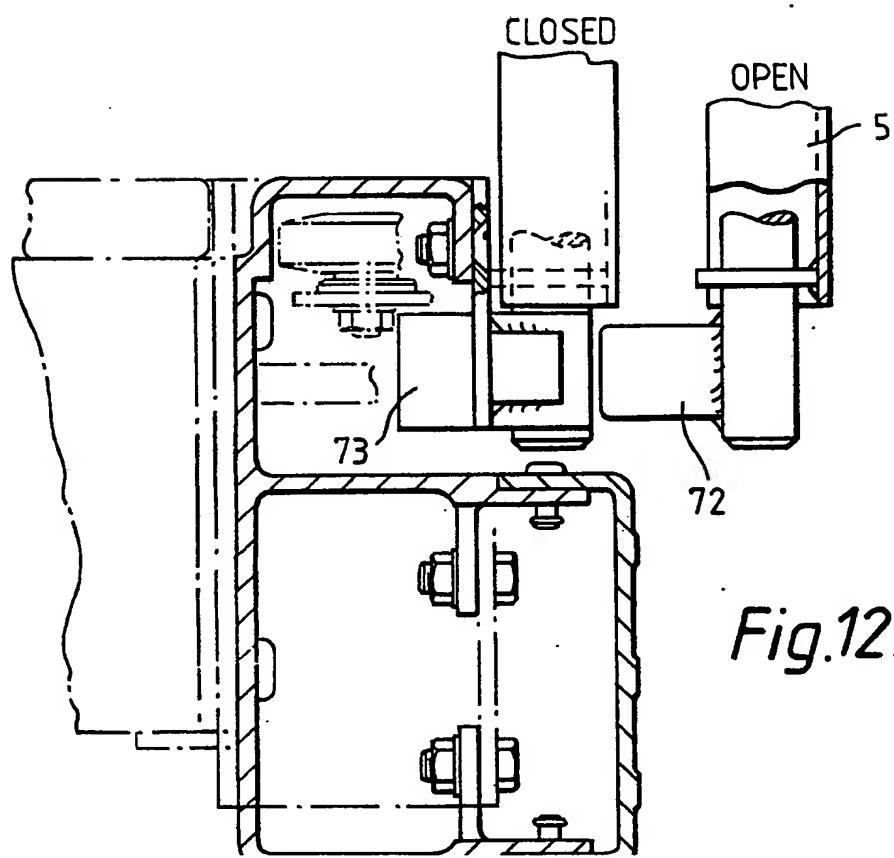
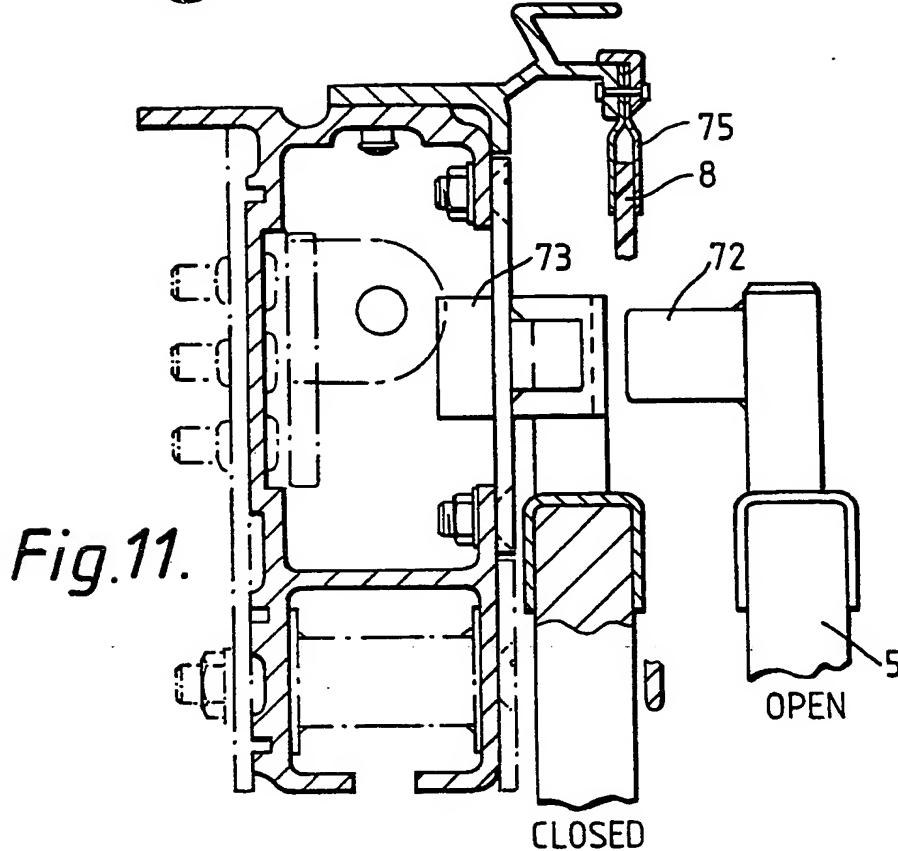


Fig. 10.





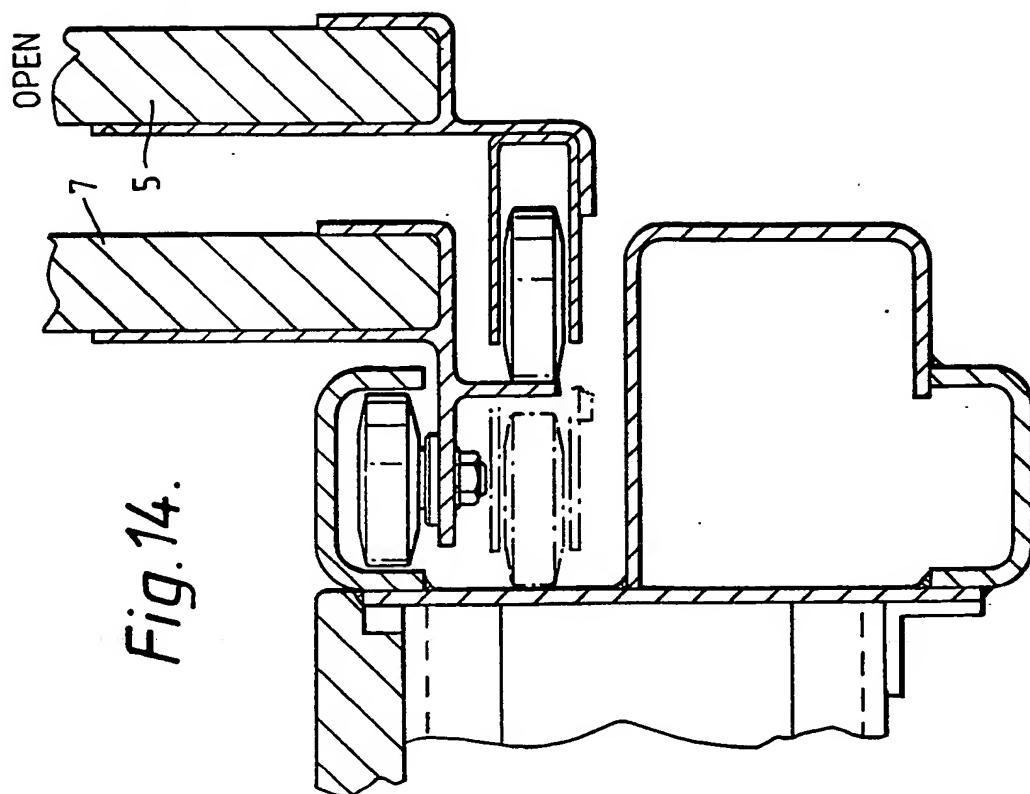


Fig. 14.

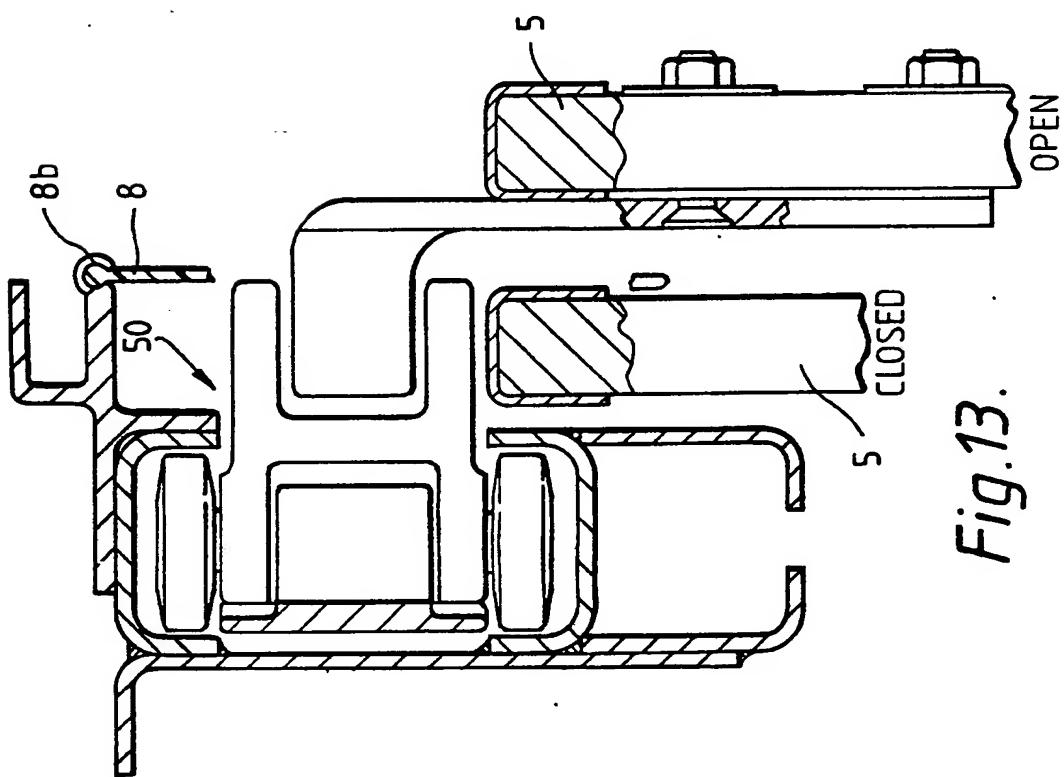


Fig. 13.

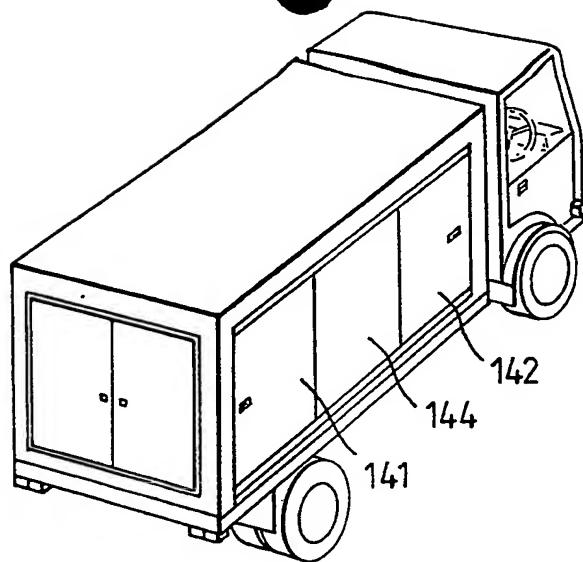


Fig. 15.

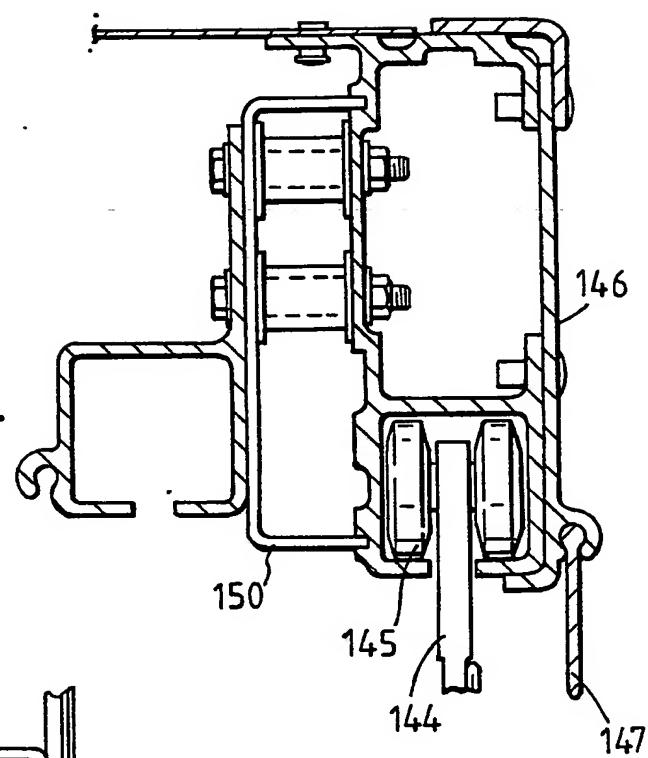


Fig. 16.

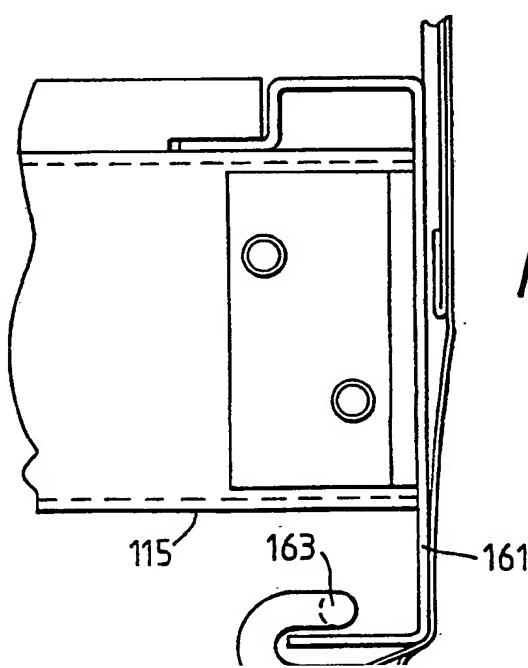


Fig. 17.

"SLIDING DOOR SYSTEM FOR VEHICLE"

This invention relates to a sliding door system for a vehicle and in particular to a system which maximizes the available load space inside the vehicle.

Many commercial vehicles use not only doors at the rear of the vehicle but also, in order to allow easier access to the load space, doors in the side of the vehicle. Commonly several sliding doors mounted in two or more tracks are used as the side doors. Many countries including the United Kingdom have laws restricting the width of road vehicles to a maximum - in the United Kingdom the present limit is 2500 mm. This means that with a vehicle having sliding side doors the spacing between the outermost edge of the door track and the outermost edge of the vehicle on the opposite side must be less than or equal to this limit. The maximum available load space inside the vehicle is thus restricted to the maximum allowable vehicle width minus the width of the sliding doors and tracks. For commercial reasons it is in general advantageous to maximize this available width, but with the increased carrying of goods on so called "Continental" pallets, which are all of a standard size of 1200 mm by 1000 mm, it has been found that the width of the pallets is such that with the conventional type of sliding door running in two or more tracks, it is not possible to fit two pallets side by side with their longest dimension across the vehicle. The pallets therefore have to be carried with their longest dimension along the length of the vehicle. This means that space is wasted at either side of the pallet and that the number of pallets which can be carried by vehicles of certain lengths is halved. If the space taken up by the rails of the sliding door system could be reduced it would be possible to fit two pallets side by side with their longest dimension across the vehicle thus reducing the wastage of space on either side and in some cases doubling the load carrying capacity of the vehicle. Unfortunately,

simply reducing the width of the doors and tracks simply results in the doors becoming less reliable in operation and less robust.

It is also known to use in commercial vehicles so called "plug-and-slide" doors in a sliding door system. In this type of system most of the doors are of the simple sliding type but one door (known as a plug-and-slide door) can be pulled out of its frame to allow it to be slid over the other doors, or to allow the other doors to slide behind it. Thus when all the doors are closed they lie flush with one another but it is possible to open the doors by pulling the plug-and-slide door out of its frame perpendicular to the sliding direction so that it can be slid over the other doors, and/or the other doors can be slid behind it. This system also use two parallel tracks disposed horizontally alongside each other, the plug-and-slide door being carried on a carriage running in one track and the simple sliding doors sliding in the other. The plug and slide door is pivotally suspended from the carriage by an L-shaped bracket. This type of system tends to have a complicated mechanism, and also requires the plug-and-slide door to be held out from the other doors while it is being slid thus requiring the operator to use two hands.

The present invention proposes a sliding door system where one door may slide over another and in which a particular arrangement of the guides on which the doors slide is used is that the required total guide width is less than twice the width required for one guide alone. This can be achieved by adopting an arrangement where the lateral extents of the guides associated with the respective doors overlap. In particular, the guide associated with one door can be vertically offset with respect to the other so that it can at least part overlie the other.

Conveniently it is the top rail of the door system which includes the overlapping door guides and there are two guides in the top rail of the door system, disposed ver

tically one above the other. Conveniently the door system includes one or more simple sliding doors which run in the lower guide and a plug-and-slide door (hereinafter referred to as a master door) which plug in the top guide. The plug-and-slide master door may be carried on a swivel arm connected to a carriage running in the upper guide. This door may be swung on the swivel arm into and out of line with the other, ordinary, door or doors. When the master door is out of line with the other door it may be slid over the other doors or vice versa. The master door may be carried on several carriages and preferably the end carriages are provided with stops so that when the doors are being closed and the master door is slid into line with the opening which it is to close, the stops abut the end of the guide and the momentum of the master door causes the swivel arm to swivel forward bringing the master door into line with the other doors. Preferably when the master door is in the in-line position it may be locked in place. Conveniently the adjacent edges of the master door and other door are have respectively a tongue and recess and the locking action of the master door is arranged to move it towards the other doors thus forcing the tongues into the recesses and thus also locking the other doors and providing a weather tight seal between the doors.

25 Preferably the bottom rail has a single guide in which run wheels attached to the lower edge of the ordinary sliding door or doors. The lower edge of the plug-and-slide master door may also be provided with wheels which, when it is being slid over the ordinary doors, run on a lip provided 30 on the lower part of those ordinary doors, and when it is closed and in line with the other doors occupies the recess formed by the guide in the bottom rail. Preferably the bottom rail is provided along its length with a detachable protective front plate which may be detached and replaced 35 when damaged.

The top and bottom rails may conveniently be

extruded aluminium members.

The invention will be further described by way of non-limitative example with reference to the accompanying drawings in which:

5 Figures 1 and 2 are schematic views of a vehicle incorporating the present invention;

Figure 3 is a cross-sectional view of the top rail and top of the doors of a sliding door system according to a first embodiment of the present invention;

10

Figure 4 is a cross-sectional view of the bottom rail and bottom of the doors of a sliding door system according to the first embodiment of the present invention;

15 Figures 5, 6 and 7 are plan, side and cross-sectional views respectively of a plug-and-slide door carriage used in the first embodiment of the present invention;

Figure 8 is a partially cut away side view of the side of a vehicle incorporating the first embodiment of the present invention;

20 Figures 9 and 10 are top views of sliding doors according to the first embodiment of the present invention;

Figures 11 and 12 show part of the locking system of the sliding doors in the first embodiment of the present invention;

25 Figures 13 and 14 are cross-sections of alternative top and bottom rails according to the present invention;

Figure 15 is a schematic view of a vehicle incorporating a second embodiment of the present invention;

30 Figure 16 is a cross-sectional view of the top rail used with the second embodiment of the present invention; and

Figure 17 is a view of the bottom rail used with the embodiment of Figure 16.

35 Figure 1 shows schematically a vehicle provided with a set of sliding doors 1 embodying the present invention. The vehicle also has a set of conventional doors 3 at

the back. The sliding doors 1 comprise two doors - a master door 5 which is of the plug-and-slide type and a single simple sliding door 7. It is possible for a vehicle with a long load space to have more than one simple sliding door and, if 5 preferred, more than one plug-and-slide master door.

Figure 1 shows the position with the doors closed and locked. With the present invention, in this position the front door 5 which is the master door is flush i.e. in line with the rear door 7 which is a simple sliding door. This 10 together with the fact that the tracks for the two rails are disposed one above the other as described below means that the maximum width of load space may be attained inside the vehicle. The front door 5 cannot, obviously, be opened by sliding it straight backwards since it is in line with the 15 rear door 7, so the front door 5 is suspended in such a way that it may first be pulled out of the opening in the side of the vehicle, i.e. moved in a direction perpendicular to the side of vehicle, to a position where it can be slid backwards over the rear door as shown in Figure 2. With the 20 master door 5 pulled-out, the rear door can also be slid forwards, behind the master door, to allow access to the rear of the load space. In order to close the vehicle the rear door 7 is slid to the rear, the master door 5 slid forwards, passing over the rear door until it is clear of 25 the rear door and aligned with its opening, and then pushed into the side of the vehicle to plug the opening where it can be locked.

Both sliding doors are suspended from a top rail 11 and run in a bottom rail 13 as will be described below. 30 A pelmet 8, which is made of a flexible material e.g. p.v.c. is also suspended from the top rail and protects the fixings from the weather. The master door 5 can be locked closed by a lock 9 of a conventional type but which tends to urge it towards the rear of the vehicle when locked. The rear edge 35 of the master door is provided with a tongue 90 (see Figure 9) and rubber seal 92 and the front edge of the simple slid

ing door 7 with a corresponding recess 99. Thus when the master door 5 is locked, the flange and rubber seal engage the recess in the rear door locking it and providing a weather-tight seal between the doors.

5 The doors 5 and 7 are made from a laminated material comprising a core of glass reinforced plastic board faced with plywood. This material is light and strong and is also a good thermal insulator.

Figure 3 shows how the two doors are suspended 10 from the top rail 11 and shows the doors in the position where the master door 5 has been slid over the other door 7. The top rail 11 is an extruded aluminium member defining two channels 11a and 11b, and is mounted on the vehicle so that the two channels are disposed vertically one above the 15 other. The top channel 11a opens towards the side of the rail 11 and the lower channel has an opening 12 in its floor. As can be seen from Figure 3 the master door 5 is suspended from a carriage 50 which runs in the top channel 11a and has a swivel arm 52 which, in the position of Figure 20 2, passes through the opening in the side of the channel and carries the master door 5 outwardly of the sliding door 7 on a pivotally mounted bracket 54.

The simple sliding door 7 is suspended from a carriage 21 (see also Fig. 8) which runs in the lower channel 11b on two pairs of wheels 23, set one behind the other, the wheels of each pair running on respective sides of the opening 12 in the channel floor. The carriage 21 has a drop arm 25 connected to its middle, between the two pairs of wheels, which extends through the opening 12 and to which is 30 attached an L-shaped bracket 27 carrying the door 7. The top of the door 7 vertically overlaps the rail 11 so that it seals the opening in the vehicle more effectively.

As can be seen in Figure 3 both doors are capped with metal caps 6 to prevent damage to the door material.

35 The flexible pelmet 8 is suspended from a bracket 10 bolted to the top of the rail 11. The pelmet is provided

with a bead 8a along its top which is retained in a recess in the bracket. As can be seen in the Figure it extends far enough downwardly to cover and protect the top of the doors and the carriages, but is flexible enough to be deflected by 5 the master door 5 when the doors are open. Alternative ways of attaching the pelmet 8 are shown on the top rails of Figures 11 and 13. In Figure 13 a bead 8a is held in a differently oriented recess 8b and in Figure 11 the pelmet is held by the two leaves of a clamp 75 bolted to a bracket 10 attached to the top rail.

Figure 4 is a sectional view of the bottom rail 13 and the lower parts of the doors 5 and 7. The bottom rail 13 is an extruded aluminium member having the section of a letter "E", which defines two channels 13a and 13b, disposed 15 vertically one above the other, both generally U-shaped and both opening to the side of the rail. The walls of the lower channel 13b extend further outwardly than the walls of the upper channel 13a and thus serve to protect the bottom edge of the doors 5 and 7. The bottom channel 13b is closed-off 20 along its entire length by a plate 15 which is bolted to its side walls. It thus forms a box section which strengthens the rail. The plate 15, which is often damaged during loading and unloading of the vehicle, can be easily removed and replaced during the lifetime of the vehicle. The top wall of 25 the upper channel 13a is bent downwardly at its outer end to form a restraining lip 17. Within the upper channel run wheels 33 mounted on a bracket 31 attached to the bottom edge of the sliding door 7. The wheel 33 is mounted on a vertical axle and is held in the channel by the restraining 30 lip 17. The bracket extends outwardly beyond the restraining lip 17 and forms a shoe 34 in which the bottom edge of the door 7 is housed. It will be appreciated that the door 7 is thus free to slide lengthwise of the vehicle but may not move inwardly or outwardly of the vehicle.

35 The bottom edge of the master door 5 is housed in one or more shoes 35 on each of which is mounted a U-shaped

bracket 36. A wheel 39 is mounted on a vertical axle 38 between the arms of each bracket 36 and serves as a bearing for the bottom edge of the master door.

As shown in Figure 4, the wheels 39 which are on the part of the master door 5 overlapping the other door 7 run on a flange 37 which extends downwardly from the bottom of the bracket 31. The bottom edge of the master door is thus held away from the sliding door 7, and the master door may be slid easily over the door 7. When the doors are closed, and the master door 5 is in line with the simple sliding door 7, the wheels 39 occupy the lower part of the channel 13a as shown dotted in Fig. 4.

Figures 5 to 7 show the carriage 50 which carries the master "plug-and-slide" door 5. The carriage 50 comprises a metal body 51 which runs on two pairs of wheels 53.

These wheels carry the main weight of the master door and run along the horizontal floor of channel 11a in the top rail 11. (Note that the wheels 53 are not shown in Figure 3). Pivotaly mounted on the body 51 between the two pairs of wheels 53 is one end of the swivel arm 52. The swivel arm 52 has an H-shape the end of which is mounted on a vertical axle 55. The axle 55 extends beyond both legs of the swivel arm and carries on each end a wheel 56. As can be seen from Figure 3 the wheels 56 run between the walls of the top and bottom portions of the channel 11a and serve to prevent the carriage 50 tipping to one side under the weight of the door and thus binding in the rail. The other end of the swivel arm is provided with an axle 57 on which is pivotally mounted the bracket 54 (see Figure 3) which is attached to the master door 5.

The swivel arm 52 is free to pivot between the position shown in full in Fig. 5 and the position shown dotted in Figure 5, thus moving the master door between the position shown in Figure 3 where it is free to pass over the sliding door 7, and a position where it is flush with the master door 7. The carriage body is also provided at each

end with brackets 58-1 and 58-2 for carrying adjustable stops 69-1 or 69-2 (see Fig. 8). These stops abut corresponding stops on the rail 11 when the master door 7 is in its fully forward or fully backward position respectively.

5 In this embodiment the swivel arm 52 is mounted so that it is pivoting in the forward direction when the master door is moving into its flush position with the other door i.e. as the door is being closed, and pivoting backwards when the doors are being opened. By suitably arranging the position-

10 ing of the stops so that the front stop 69-1 abuts the front stop of the rail 11 when the master door is just clear of the sliding door 7 and aligned with the opening it is to close, the momentum of the master door as it slides forwards will tend to cause the swing arm 52 to pivot forwards to the

15 dotted position in Figure 4 thus moving the master door 5 into line with the door 7 and plugging the opening in the vehicle. Similarly when the master door is unlocked and being opened, simply pulling backwards on the master door tends to swivel the swivel arm out so that it is perpendicu-

20 lar to the rail 11 and thus moves the master door 5 clear of the other door 7. In order to achieve this "automatic" action it is preferable for the swivel arm to be prevented from swivelling backwards to an angle greater than about 90 degrees to the carriage body 51. This is achieved in this

25 embodiment by a stop 59 on the swivel arm. In this embodiment of the invention several carriages 50 are used and they are connected together with tie bars 89 (see Fig 8) to prevent them spreading or bunching during sliding of the door. It will be apparent that the carriage shown in Figures 4 to

30 6 is suitable for doors on one side (the left hand side facing forwards) of a vehicle. Similar carriages which are mirror images of the one shown will be required for doors on the other side of the vehicle.

Figure 8 is a side view of the master door 5 in 35 position on the vehicle. As can be seen the master door is suspended from two carriages 50 connected by a tie-bar 89.

Adjustable stops 69-1 and 69-2 are mounted on the end carriages, the front stop 69-1 abutting the end of the rail 11 when the master door is slid fully forwards.

As can be seen from Figure 8 cut-outs 110 are 5 provided in the rail to allow the carriages 50 to be removed for maintenance or replacement.

As can be seen from Figures 8, 11 and 12 the doors are locked by a single locking bar 70 provided with bolts 72 and a safety latch 74. There are two bolts, one at 10 the top and one at the bottom of the door. The lock is operated by swivelling the locking bar 70 using a handle 9 (see Figures 1 and 2) on the outside of the door, to swivel the bolts 72 into corresponding holes 73 in the door frame to prevent forward and backward movement of the door. The 15 safety latch 74 which is a curved metal plate attached to the locking bar prevents the master door from pivoting out of the doorway on its swivel arms while the vehicle is in motion. The locking mechanism is so arranged to urge the master door towards the back of the vehicle as it is being 20 locked. As can be seen from Figure 10 the rear edge of the master door 5 is provided with a tongue 90 and rubber seal 92 while the front edge of the sliding door 7 has a corresponding recess 94, so that the movement of the master door rearwardly under the action of the locking mechanism causes 25 the tongue 90 to enter the recess 94 thus preventing the sliding door from moving and locking the two doors together. The rubber seal 92 provides a weather tight seal between the doors. As can be seen from Figure 10, the rear edge of the sliding door also has a tongue 97 which, on locking, enters 30 a recess 99 in the door frame.

In the embodiment described above the top and bottom rails are extruded aluminium members and these are preferred for their lightness and strength. However, it is also possible for the rails to be fabricated from several 35 pieces of metal as shown in Figures 13 and 14.

One of the advantages of the illustrated embodiment

ment is that the top and bottom rails may also be used with different types of closure for the vehicle. For instance a combination of p.v.c. curtains and doors may be used. Figure 15 shows schematically a combination of sliding doors and 5 curtain, and Figure 16 shows how the top rail is adapted to this type of vehicle. In Figure 14 two sliding doors 141, 142 are used with a p.v.c. curtain 144 between them. In this embodiment it is not necessary for the doors to pass over one another and so both are suspended from the lower channel 10 in rail 11. The curtain 144 is also suspended from the lower channel as can be seen from Figure 16. The curtain 144 is suspended from several wheeled hangers 145. The bottom of the curtain is attached to the bottom rail by several claws which hook behind the restraining lip 17 and are free to 15 slide along the bottom rail. Opening either of the doors causes the curtain 144 to bunch up between the doors as its hangers and claws slide along the top and bottom rails respectively. In order to provide additional weather protection to the top fastenings a pelmet carrier 146 is fitted to 20 the front of the rail and carries a flexible pelmet 147 extending downwardly over the top part of the doors and curtain. The pelmet carrier 146 also blanks-off the top channel in the rail.

Alternatively the doors may be replaced completely by curtains. In this case a different type of bottom rail is used as shown in Figure 17. This rail is provided with an L-shaped flange 161 extending from its underneath around which hooks 163 attached to the bottom of the curtain may be hooked.

30 Figure 16 shows the use of an additional, optional feature which may be fitted to the top rail in any of the embodiments described above. In Figure 16 a strengthening piece 150 is attached to the back of the top rail. This strengthening piece is in the form of a C-shaped length of 35 steel rail which is bolted to the back of the top rail. Such a strengthening piece can be used whenever the top rail is particularly long and thus particularly prone to bending.

CLAIMS

1. A sliding door system including a plurality of sliding doors each running longitudinally of one of at least two guides at least two of the guides being arranged so that their lateral extents overlap.
2. A sliding door system according to claim 1 wherein the overlapping guides are offset with respect to one another substantially perpendicularly of their lateral extent.
3. A sliding door system according to claim 1 or 2 wherein the doors are suspended from carriages running in the guides.
4. A sliding door system according to claim 1, 2 or 3, wherein the guides are formed in a single guide rail.
5. A sliding door system according to claim 4 wherein a further guide rail is provided for guiding the bottom of at least one of the doors.
6. A sliding door system according to claim 5 wherein the further guide rail is formed by an inverted channel section member and at least one of the doors is provided with a runner disposed between the two walls of the channel.
7. A sliding door system according to any one of the preceding claims wherein one of the doors is a master door which may be moved into a position out of line from the at least one other door so that the master door may be slid over the at least one other door.

8. A sliding door system according to claim 7 wherein one of the guides carries only the master door.

9. A sliding door system according to claim 8 wherein said one guide is disposed above the at least one other guide rails.

10. A sliding door system according to claim 7, 8 or 9 wherein the master door is suspended from at least one carriage which is free to run in a guide, the carriage including a swing arm from which the master door is suspended and movable between two positions; a first, in which the master door is in-line with the at least one other door; and a second in which the master door is out-of-line with the other door so that the master door can be slid over the at least one other door.

11. A sliding door system according to claim 10 wherein the carriage is provided with a stop to abut a stop on the guide when the master door is positioned over the opening it is to close, and wherein the swing arm is free to move in such a direction that the momentum of the master door being slid towards the closed position against the stops causes it to pivot from the second position to the first.

12. A sliding door system according to claim 11 wherein at least one of the stops is adjustable.

13. A sliding door system according to claim 10, 11 or 12 wherein the carriage runs in a guide having a channel-shaped cross-section, the top limb of the channel

being provided with a downwardly extending flange and the carriage with a runner disposed to run between the flange and web of the channel to prevent the carriage tipping out of the rail.

14. A sliding door system according to claim 13 wherein the bottom limb of the channel section is provided with an upwardly extending flange and the carriage with a further runner disposed to run between that flange and the web of the channel.

15. A sliding door system according to claim 13 or 14 wherein said runner and/or further runner is mounted on an axle on which the swing arm pivots.

16. A sliding door system according to any one of claims 10 to 15 wherein the guide is provided with a floor and the carriage with wheels to run on the floor.

17. A sliding door system according to any one of claims 10 to 16 wherein the master door is suspended from a plurality of carriages connected together by tie-bars.

18. A sliding door system according to any one of claims 7 to 17 wherein the bottom of the master door is provided with a further wheel and the bottom of the at least one other door with a track on which said further wheel may run when the master door is slid over the at least one other door.

19. A sliding door system according to claim 18 wherein the track is formed by a flange extending from the bottom of the at least one other door.

20. A sliding door system according to any one of claims 7 to 19 wherein a lock is provided to prevent the master door moving out-of-line from the at least one other door when it is closed.

21. A sliding door system according to any one of the preceding claims wherein a lock is provided to lock at least one of the doors to the door frame, the abutting edges of the doors being provided with one of a complementary tongue and groove and wherein the lock is adapted to urge the doors together as it is locked to force the tongue into the groove to lock the doors together and provide a seal between the doors.

22. A sliding door system according to claim 6 wherein the channel-section member includes a box section portion to stiffen the further guide rail.

23. A sliding door system according to any one of the preceding claims wherein a flexible pelmet is provided to protect the guides and edges of the doors.

24. A sliding door system constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

25. A vehicle including a sliding door system according to any one of the preceding claims.

26. A vehicle according to claim 25 including such a system on each side.